(12) UK Patent Application (19) GB (11) 2 285 067 (13) A

(43) Date of A Publication 28.06.1995

(21) Application No 9326165.9

(22) Date of Filing 22.12.1993

(51) INT CL[6]
D02G 3/44, C09K 3/10, D02G 3/02, F16J 15/22, //
D02G 3/04 3/16

(52) UK CL (Edition N)
D1W W4 W7A
FZB B13B2B B13B2E
U1S S1781 S1901 S2003

(56) Documents Cited
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(58) Field of Search
UK CL (Edition M) D1W, FZB
INT CL[5] C09K 3/10, D02G 3/00 3/02 3/06 3/16 3/22 3/36 3/38 3/40 3/44, F16J 15/20 15/22
Online databases:WPI

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(54) Gland packing yarn

(57) A gland packing yarn (10) comprises an elongated resilient core (12) and at least one layer of extrusion-inhibiting fibres (18). The core (12) comprises at least one strip of flexible graphite foil (14) and the fibres (18) which may be or carbon are arranged to extend parallel to one another and are adjacent to one another, either axis-parallel or helically. The yarn may be formed by adhesively laminating sheets of graphite foil and of carbon fibres to form layers (14, 18), cutting the laminate into separate yarn-forming strips and rolling the strip to form a round yarn (10). Alternatively a single layer of graphite foil and one of fibres may be joined together and then folded over to form a yarn. Yarns may be braided to form a packing.

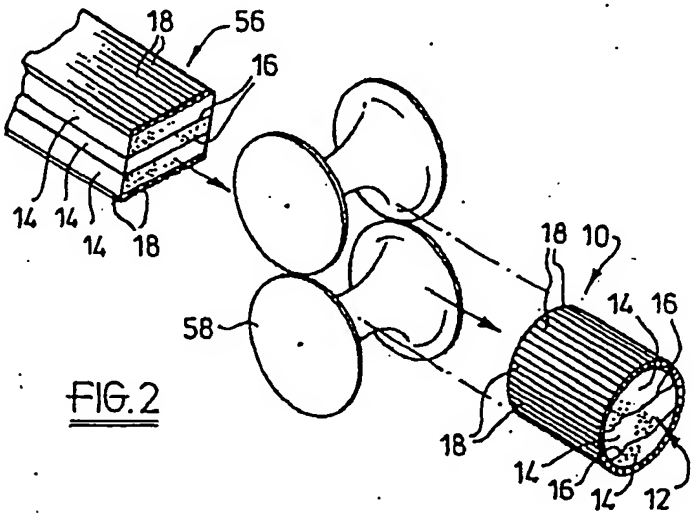

FIG.2

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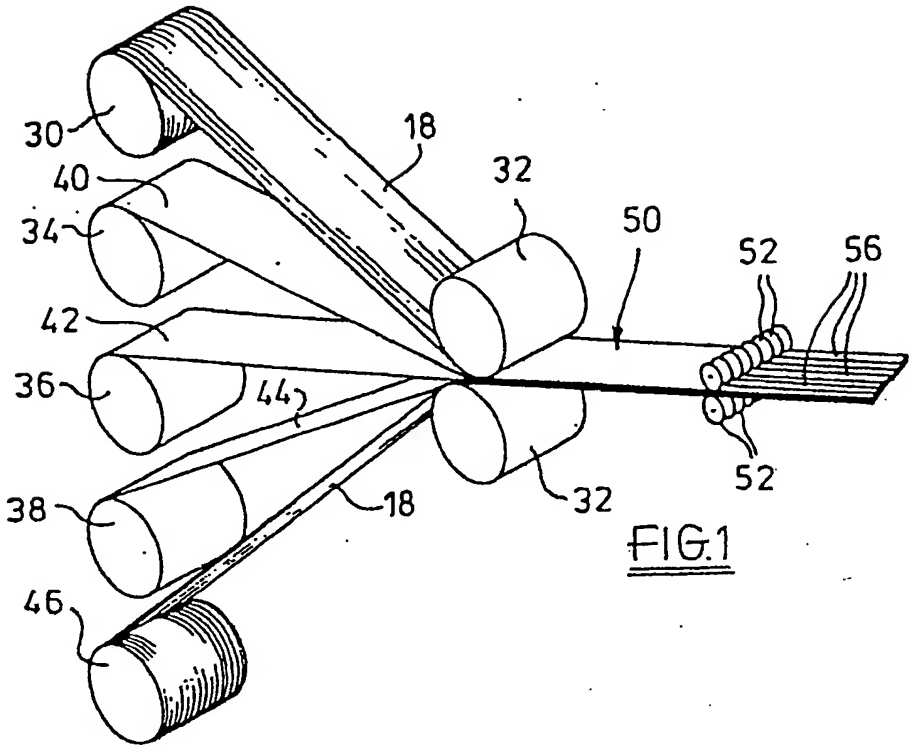
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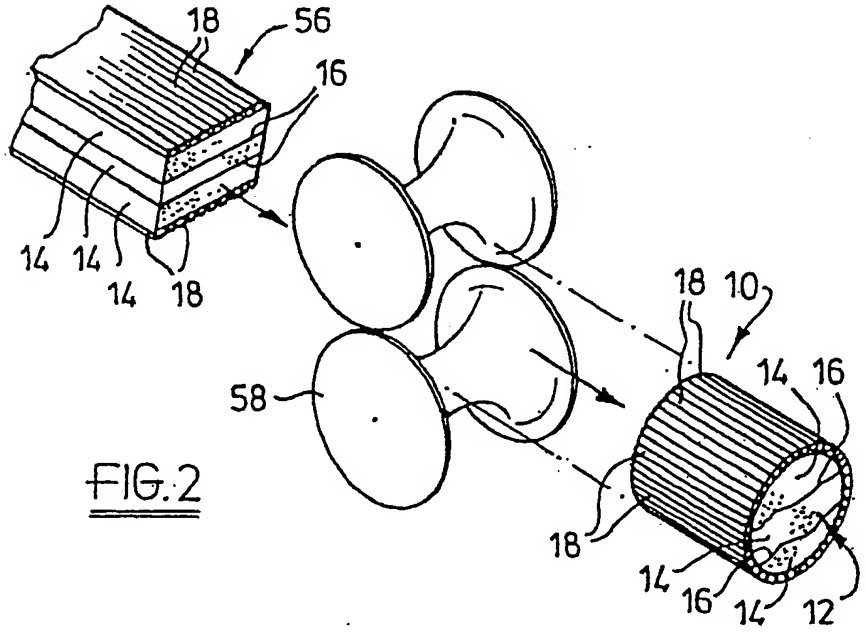
FIG.1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12

FIG.2

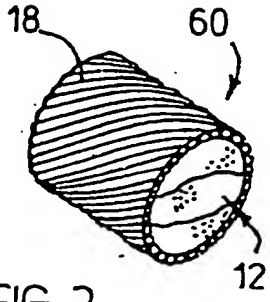

FIG. 3

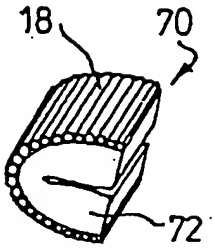

FIG.4

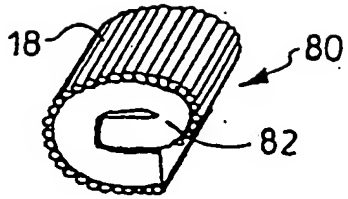

FIG.5

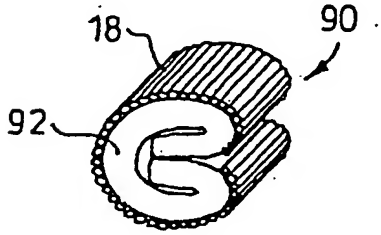

FIG.6

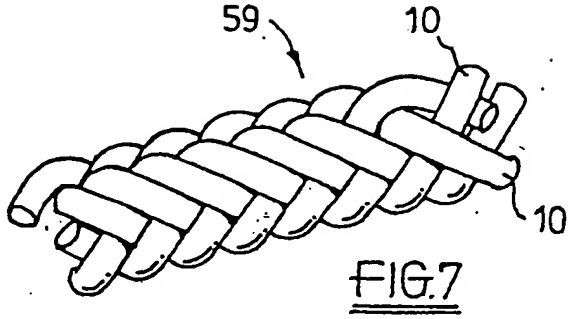

FIG.7

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Gland Packing Yarn

This invention is concerned with gland packing yarn and with a method of manufacturing such gland packing yarn.

In fluid handling systems, such as valves or pumps, where a moving shaft extends through a fluid-containing wall, a seal is required around said shaft. Such seals are often provided by packing a resilient gland packing material, made from a plurality of lengths of yarn braided or pleated together, around the shaft. The packing material is contained in a chamber known as a "stuffing box". The gland packing material must form a tight seal around the shaft while presenting a low-friction surface to the moving shaft. Additionally, the gland packing material must also be stable in the operating environment.

The most common resilient materials used in the gland packings are asbestos and flexible graphite (also known as exfoliated graphite or expanded graphite). Flexible graphite has good resilience, good formability and good temperature resistance. It is also chemically resistant to many fluids encountered by gland packings in practice and is inherently a low-friction material. However, flexible graphite has the disadvantage that it tends to be extruded into the space between the shaft and the opening into the stuffing box through which the shaft passes. The flexible graphite may also build up as a deposit on the shaft. These problems can be reduced by cladding the flexible graphite core of a gland packing with a knitted or braided sleeve of carbon fibres (see US patent number 4,705,722).

However, the provision of such a knitted or braided sleeve does not prevent extrusion occurring through the spaces between the fibres in such a sleeve. Furthermore, it is not easy to provide a knitted or braided sleeve of sufficiently small dimensions and providing such a small diameter sleeve is expensive.

It is an object of the present invention to provide a yarn which allows a gland packing to be made which has a more efficient barrier to extrusion of flexible graphite forming a core of the yarn.

The invention provides a gland packing yarn comprising an elongated resilient core and at least one layer of extrusion-inhibiting fibres secured to an outer surface of the core, the core comprising at least one strip of flexible graphite foil, wherein the fibres are arranged so that they extend parallel to one another and are adjacent to one another.

It is found that in a gland packing yarn according to the invention, the fibres provide a more efficient barrier against extrusion of the flexible graphite and such a layer is easier to provide than a knitted or braided sleeve. Furthermore, such a barrier represents a more efficient use of the relatively expensive fibres.

The core of a gland packing yarn according to the invention may comprise a plurality of strips of flexible graphite foil overlying one another and secured together by adhesive.

The extrusion-inhibiting fibres may be carbon fibres which can be secured to the core by adhesive.

The invention also provides a gland packing formed from a plurality of lengths of yarn according to the

invention. The lengths of yarn can be braided, plaited or otherwise combined to form the packing.

The invention also provides a method of manufacturing a gland packing yarn comprising securing at least one layer of extrusion-inhibiting fibres to one or more surfaces of an elongated resilient core comprising at least one strip of flexible graphite foil so that the fibres extend parallel to one another and are adjacent to one another, the method also comprising folding or coiling the core so that the fibres are formed into a layer around the core. Said fibres may be secured to a sheet of flexible graphite foil eg by adhesive, which is then slit into strips which are first coiled or folded to form the gland packing yarn.

The invention also provides a method of manufacturing a gland packing by manufacturing yarn by a method in accordance with the invention and braiding or plaiting lengths of the yarn together.

There now follows a detailed description, to be read with reference to the accompanying drawings, of five illustrative gland packing yarns in accordance with the invention and also of an illustrative method of manufacturing said yarns.

In the drawings:

Figure 1 is a diagrammatic perspective view of various stages in the illustrative method;

Figure 2 is a diagrammatic perspective view of further stages in the illustrative method;

Figures 3 to 6 are diagrammatic views of the second to fifth illustrative gland packing yarns; and

Figure 7 is a diagrammatic perspective view of a gland packing made from the yarn shown in Figure 3.

The illustrative method is for making a gland packing yarn 10 which is illustrated in Figure 2. The yarn 10 comprises an elongated resilient core 12 which is generally cylindrical in shape and comprises three strips 14 of flexible graphite foil which are overlying one another and secured together by adhesive 16. The yarn 10 also comprises a layer of extrusion-inhibiting carbon fibres 18 secured to an outer surface of the core 12. The fibres 18 are arranged so that they extend parallel to one another and are adjacent to one another.

The first illustrative yarn 10 is manufactured by the method illustrated in the Figures 1 and 2. Figure 1 shows the apparatus used in a first stage of the illustrative method. This apparatus comprises a series of reels 30 each of which has a supply of carbon fibre thereon. The reels 30 are arranged in a bank so that a plurality of carbon fibres can be supplied therefrom with the fibres extending parallel to one another and adjacent to one another. These fibres 18 are supplied to the nip between two rollers 32. The apparatus also comprises three feed rolls 34, 36 and 38 each of which supplies a sheet of flexible graphite foil, 40, 42 and 44 respectively. These sheets of flexible graphite are also supplied to the nip between the rollers 32. The sheet 40 has adhesive on its upper surface which at the nip engages the fibres 18 from the reels 30 so that this adhesive secures the fibres to the top of the sheet 40. The sheet 42 has adhesive on the upper surface thereof so that the sheet 42 is secured to the sheet 40. The sheet 44 has adhesive on both the upper and lower surfaces thereof. The adhesive on the upper surface secures the sheet 44 to the sheet 42 and the adhesive on the lower surface secures further fibres 18 supplied from a further bank of reels 46 to the foil sheet 44. Thus, the rollers 32, which may be heated and which apply pressure to the stack comprising the three sheets 40, 42 and 44 and two layers of fibres 18, serve to compress the stack into a

composite sheet 50 which passes away from the rollers 32. This composite sheet 50 is slit by slitting wheels 52 located downstream of the rollers 32 into a series of strips 56, one of which is shown in Figure 2.

The remainder of the method of making the first illustrative yarn 10 is shown in Figure 2. In this part of the method, each strip 56 which is of rectangular transverse cross-section, is deformed by deforming rollers 58 to have a circular transverse cross-section. This causes the two layers of carbon fibres 18 to form a continuous cylindrical layer around the core 12 which is made up from the three strips of flexible graphite foil.

Lengths of yarn 10 are then braided to form a gland packing 59 a shown in Figure 7.

The second illustrative gland packing yarn 60 shown in Figure 3 is of similar construction to the first illustrative yarn 10 but has been subjected to a longitudinal twisting operation so that the fibres 18 extend parallel to one another helically along the length of the yarn 60. The second illustrative yarn 60 is manufactured by a similar method to the first illustrative yarn 10 but with an additional twisting operation after the operation shown in Figure 2.

Figures 4, 5 and 6 show the third illustrative gland packing yarn 70, the fourth illustrative gland packing yarn 80 and the fifth illustrative gland packing yarn 90, respectively. The yarns 70, 80 and 90 are manufactured by securing parallel and adjacent carbon fibres 18 to one surface of a strip of flexible graphite 72, 82 and 92 respectively. These strips are wider than the strips 14 described above but form the core of the yarns. In the case of the yarn 70, the strip 72 is covered entirely with fibres 18 on one surface thereof and the strip 72 is then

folded in half and the two halves secured together by adhesive. This means that the layer of fibres 18 covers all the outer surface of the yarn 70 except for the two edges of the strip 72. In the case of the yarn 80 the strip 82 is covered entirely on one side with parallel and adjacent fibres 18 and the strip 82 is then folded into a small spiral. In the case of the yarn 90, the fibres 18 cover one surface of the strip 92 except for edge portions of said strip. These edge portions are folded over and the strip is then folded in half so that the core formed by the strip 92 has the shape of a "U" with the two upper edges of the arms folded inwardly towards the base of the U. This means that the fibres 18 form a substantially continuous layer around the yarn 90.

CLAIMS

1 A gland packing yarn comprising an elongated resilient core and at least one layer of extrusion-inhibiting fibres secured to an outer surface of the core, the core comprising at least one strip of flexible graphite foil, wherein the fibres are arranged so that they extend parallel to one another and are adjacent to one another.

2 A yarn according to Claim 1, wherein the core comprising a plurality of strips of flexible graphite foil overlying one another and secured together by adhesive.

3 A yarn according to either one of claims 1 and 2, wherein the fibres are carbon fibres.

4 A yarn substantially as hereinbefore described with reference to, and as shown in, any one of Figures 2 to 6 of the accompanying drawings.

5 A gland packing formed from a plurality of lengths of yarn according to any one of claims 1 to 4.

6 A method of manufacturing a gland packing yarn comprising securing at least one layer of extrusion-inhibiting fibres to one or more surfaces of an elongated resilient core comprising at least one strip of flexible graphite foil so that the fibres extend parallel to one another and are adjacent to one another, the method also comprising folding or coiling the core so that the fibres are formed into a layer around the core.

7 A method according to Claim 6, wherein the said fibres are secured to a sheet of flexible graphite foil which is then slit into strips.

8 A method of manufacturing a gland packing substantially as hereinbefore described with reference to the accompanying drawings.

Patents Act 1977 Examiner's report to the Comptroller under Section 17 (The Search report)	Application number GB 9326165.9
Relevant Technical Fields (i) UK Cl (Ed.M) D1W; F2B (ii) Int Cl (Ed.5) C09K 3/10; D02G 3/00,3/02,3/06,3/16,3/22,3/36,3/38,3/40,3/44; F16J 15/20,15/22 Databases (see below) (i) UK Patent Office collections of GB, EP, WO and US patent specifications. (ii) ONLINE DATABASES: WPI	Search Examiner ALEX LITTLEJOHN Date of completion of Search 7 MARCH 1994 Documents considered relevant following a search in respect of Claims :- 1-8

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E: Patent document published on or after, but with priority date earlier than, the filing date of the present application

&: Member of the same patent family, corresponding document

Category	Identity of document and relevant passages		Relevant to claim(s)
Y	GB 2243883 A	(KEMPCHEN) see whole document, eg page 1 line 18 and page 2 line 4 to page 3 line 5	1,2,3,5
Y	GB 298766	(FRASER) see eg page 2 lines 82, 83 and page 3 lines 77-82	1,2,3,5
X,Y	EP 0340303 A1	(NIPPON PILLAR) see whole document, especially page 15 lines 15,16	X: 1,2,3,5 Y: 1,2,3,5
Y	US 5225262	(LEDUC) see whole document	1,2,3,5
Y	US 4705722	(UEDA) see whole document	1,2,3,5

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